The Model Engineer

A Journal of Small Power Engineering.

Edited by Percival Marshall, C.I.Mech.E.

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Our Point of View.

Climbing out of Ruts.

Model engineering may seem to some of us a rather too prosaic and specialised sort of business to attract to itself the individual who is capable of great breadth of vision; or, to put it another way, one could reasonably presume that the very concentration necessarily given to the production of precise work such as the best model making requires, would inevitably lead one into a mental rut out of which it might be difficult to climb. That this is so we have from time to time recurring evidence. For instance, not long ago a caller told us, for our good, that we didn't publish half enough matter on a certain subject, that as a consequence he never took the *M.E.* now, and he thought it was time we altered our policy to bring things more into line with his views. Asked how he could with such confidence criticise the contents of the *M.E.* when he never saw the paper, he replied, "Oh, I look through a friend's copy now and then!" On another occasion when due to extraordinary pressure on our space a contributor's short article was unavoidably held up for a while, we were told that he too was becoming less and less enthusiastic and would eventually have to drop the paper altogether! Such instances of self-centring mentality are, perhaps fortunately, somewhat rare, but nevertheless they lend colour to the possible truth of our first supposition—*i.e.*, that great breadth of vision is not a marked characteristic of every model engineer. On the other hand, evidence of a contrary nature is not difficult to find. Read, for instance, the letter from "Linkhead" that appears in our Practical Letters columns in this issue, and then say which, all things considered, is the wiser attitude to cultivate.

Model Engineering Supplies Abroad.

In these days when the mere mention of the term Government Department is apt to make the man in the street think many undesirable thoughts, it is appropriate that some authoritative voice should be heard more than occasionally in support of any genuine good service on the part of any such department for the benefit of British trade generally. Such a voice is that of Sir William Joynson-Hicks, M.P., whose foreword in the little handbook just issued by the Department of Overseas Trade (Development and Intelligence) is a fitting introductory to the matter which follows it. The handbook is intended to interest and help both large and small traders and manufacturers in this country. It explains so far as is possible in so few pages the aim and object of the department, and shows in some measure in what manner of ways the officials concerned can assist the trader—the small trader, let us repeat, as well as the large—who is in search of suitable foreign markets for his goods; or who wishes not only to develop his existing export trade but to get established on entirely new ground. It must be emphasised, however, that the department has nothing to do with regulation of trade; it passes no measures and makes no restrictive or regulative orders. It's "is the policy of assistance without interference." The products of the model and light engineering industries in this country are in many respects unrivalled abroad—when they get there. The unfortunate fact is that they too seldom get there, but when they do they are usually welcomed and respected. It is not our products at which the overseas buyer or user grumbles, but our business methods. In that respect we still have very much to learn. The perusal of the handbook

of which we are speaking may therefore be of considerable value to many of our readers who are engaged in one way or another with small power engineering, and if it does nothing more than act as a reminder of the fact that possibly there are yet new worlds to conquer if only they are attacked in a proper fashion it will have served its purpose full well. It may be had from The Department of Overseas Trade, 35, Old Queen Street, Westminster, S.W.1.

* * *

Men and Models.

The position for us is rather uncomfortable. We do not know whether to chide our Rhodesian correspondent for an unpardonable curiosity, or commend his desire for what we verily believe it is—a quite natural wish to know the men as well as their models. His invitation, if universally accepted, would, we are certain, furnish many surprising results, for there is no other occupation for leisure hours which recruits its devotees from such widely different types and classes of the community We hope, however, that in printing the following letter we are not causing unnecessary embarrassment to the innocent celebrities referred to. They will undoubtedly use their discretion in replying to any of the points at issue. The letter runs:—I am sure it would interest many of your readers besides myself, if you occasionally gave us a short account of the celebrities in the model engineering world, with photographs, and saying how they earn their living, etc. Take, for instance, Mr. J. C. Crebbin. He is always very much to the fore with his splendid models, and I, for one, am very interested, and continually wondering what his ordinary everyday occupation is. For all I know, he may be President of a railway, or greaser on a Thames steamboat, but whatever he is, I will lay that he knows his job! I should like to see a good photo. of him, too; all I have seen so far have been taken in a haze of steam from "Cosmo Bonsor." Similarly with all the other lions, Mr. Conybeare, Mr. Westmorland, L.B.S.C., etc. I want to know what they do when not building models, whether they make much money, or have to jog along on a pound or so a week, whether they ever lose their jobs and have to look for another, like some of us smaller fry; in short, some intimate details of their life and work, to enable us to feel that we really know them. When one looks at a really fine piece of workmanship, I think one instinctively wonders what sort of man made it, and whether he is high up in his profession, or on the bottom steps; whether he had to scrape and save in order to get the material, or if a cheque for a few hundreds means nothing to him. Also, whether he has ample time on his hands, or only an hour or so in the evenings after a hard day's work. All this, I am sure, would be of great interest to many of your readers.—G. W. A."

P.O. Shabani, Rhodesia.

Books Received.

Mechanical Engineering.

PRINCIPLES AND PRACTICE OF TOOTHED GEAR WHEEL CUTTING. By G. W. Burley, B.Sc., A.M.I.Mech.E., etc. 347 illus., 24 tables, 468 pp., 8vo, cloth. (Scott Greenwood, 1922.) Price 25s. net (post free, 26s.).

Contents:—Fundamental principles of toothed-gearing — Types of toothed-gear wheels — Toothed-gear wheel elements—Shop measurement of toothed-gear elements—Principles of non-generating methods of cutting—Form cutters and tools—Form milling cutter practice—Form planing and shaping tool practice—Template guides—Principles of generating methods of cutting—Generating cutters and tools—Generating practice—Planing and shaping—Milling, grinding and hobbing—Index.

Meteorology.

AN INTRODUCTION TO FORECASTING THE WEATHER. By F. Raymond Zealley, F.R.Met.Soc. 12 illus., 32 pp., crown 8vo, sewed. (Heffer, Cambridge, 1922.) Price 1s. net (post free, 1s. 1d.).

Contents:—Compilation of weather map—Buys Ballots' Law—Beaufort scale of wind—Weather signs—Beaufort notation—Cyclone—Anti-cyclone—Secondary depression—V-shaped depression — Wedge of high-pressure — Col — Straight Isobar—Notes.

Domestic Handbook.

THE WRINKLE BOOK. By Archibald Williams. 382 illus., 526 pp., 8vo, cloth. (Nelson, 1922.) Price 7s. 6d. net (post free, 8s. 3d.).

Contents:—The house—Clothes, laundry, etc. Cookery—Mechanics and the workshop—Gardening—Pets and live-stock—Entertainments and games—Sports and pastimes—Medicine and hygiene—Business hints—Legal hints—Calculations—Various—Index.

Workshop Handbook.

THE MECHANIC'S FRIEND. By Archibald Williams. 209 illus., 416 pp., 8vo, cloth. (Nelson, 1922.) Price 7s. 6d. net (post free, 8s. 3d.).

Contents:—Metalworking — Woodworking — Machinery — Hydraulics — Electrical —Calculations—Measurements—Various—Index.

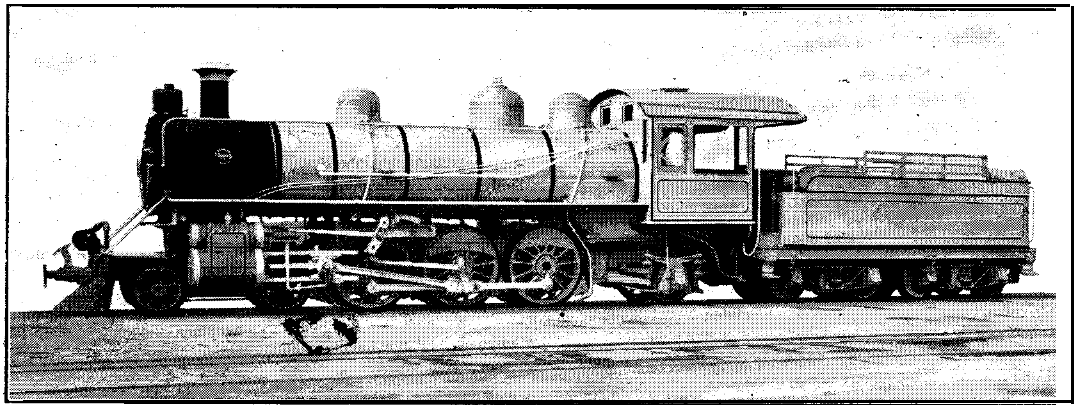
"Loco" (Plymouth).—The book you refer to may be had from our Book Department, at 66, Farringdon Street, London, E.C.4, for 15s. 6d., post free.

Locomotive News and Notes.

By CHAS. S. LAKE, A.M.I.Mech.E., M.Inst.L.E.

BALDWIN LOCOMOTIVES FOR THE MALAY PENINSULA.

By the courtesy of the Baldwin Locomotive Works there is illustrated herewith a "Pacific" locomotive constructed by them for the Federated Malay States. This system owns and operates over 1,000 miles of metre gauge track. The main line runs practically the length of the Malay Peninsula, connecting Bangkok with Singapore. From this main line there are various other small branch lines for local passenger and freight service. The motive power consists of 202 steam locomotives of various types with tenders, 560 passenger coaches, and 4,154 freight wagons. In addition to this the railway operates a marine service consisting of steam boats, tugs and ferries, also owning harbours, docks and wharves.



A Metre Gauge Pacific Type Freight and Passenger Locomotive for the Federated Malay States.

The "Pacific" type locomotive illustrated has been introduced for working combined passenger and freight service, being thus classified as a mixed traffic engine. The cylinders are outside the frames, with piston valves above them, Walschaerts valve gear being used for aatuating the valves. The cylinders measure 17 in. diam. by 24 in. stroke, the piston valves having a diameter of 8 in. The engines are equipped with American design superheaters and weigh approximately 80 tons, including the tender fully loaded.

HEAVY "GARRATT" LOCOMOTIVES FOR SOUTH AFRICA.

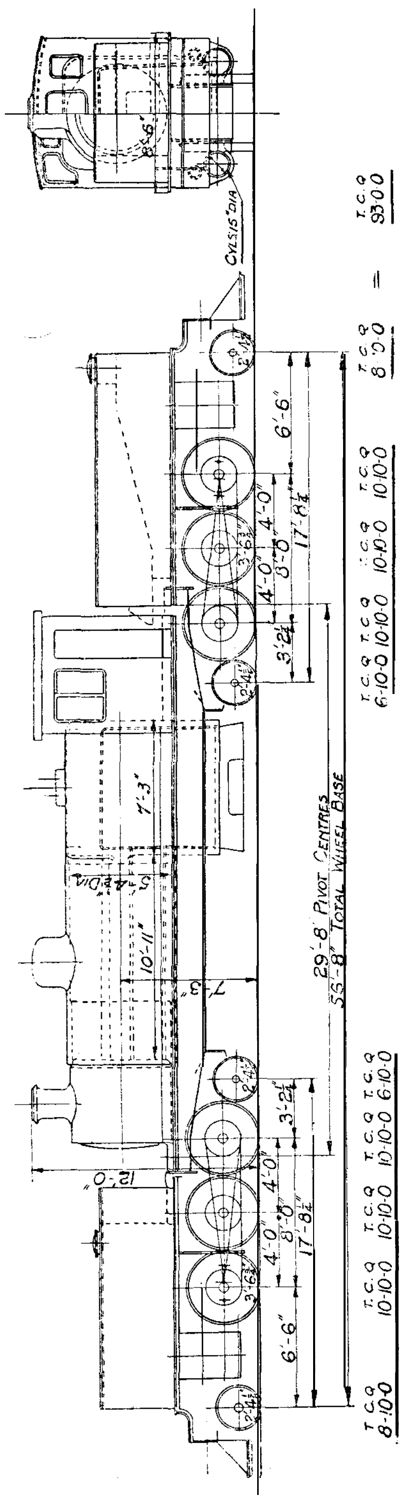
An order for the construction of two "Garratt" locomotives having the 2-6-2 wheel arrangement, and weighing 93 tons each, was recently placed with Beyer, Peacock and co., Ltd., Manchester, by the New Cape Central Railway. The engines are required for working passenger trains from Ashton to Mossel Bay, which forms part of the through route between Cape Town and Port Elizabeth. These trains consist of seven bogie roaches having an aggregate weight of 270 to 280 tons; the length of run is 190 miles, and eastbound trains have to negotiate 94 gradieats of 1 in 40, the aggregate length of these grades being $13\frac{1}{2}$ miles. The largest continuous rise is one of 2 miles 32 chains, and in many cases the grades are combined with 5 chain curves. Very similar conditions exist an the westward run.

At the present time two locomotives are used on these trains, but, with a view to dispensing with this double surface and securing greater economy of working, the company. decided, owing to the successful results obtained with the "Garratt" engines on the Union of South African Railways, to adopt the type for service on the railway referred to above.

The new engines embody in the construction the experience gained in the working of the different types of "Garratt" locomotives in South Africa, and thus will represent the latest development of the type. The accompanying diagram is from the original kindly supplied by the buiiders.

The boiler will be fitted with superheater, and the grates with rocking fire bars suited for burning native coal. The cylinders are equipped with piston valves actuated by Walshaerts valve gear. Both steam and automatic brakes will be fitted to all coupled wheels.

The following are the leading pat-ticulars :-



Outline Elevation of a New Heavy "Garratt" Locomotive for the New Cape Central Railway, South Africa.

Cylinders, diameter, 15 ins.
Cylinders, stroke, 22 ins.
Coupled wheels, diameter, 3 ft. 6¾ ins.
Coupled wheelbase, S ft.
Total wheelbase, 56 ft. S ins.
Boiler working pressure, 180 lbs.
Total heating surface—
Boiler tubes, 1530.5 sq. ft.
Boiler heating firehox, **153.5** sq. ft.
Boiler heating superheater, 333.0 sq. ft.
Total, 2019.0 sq. ft.
Grate area, 33.9 sq. ft.
Tractive effort at 75 per cent. boiler pressure, 31,250 lbs.
Tank capacity, 3,000 gallons.
Fuel capacity, 4 tons.
Weight (full and in working order), 93 tons.
Weight (full and in working order) adhesion, 63 tons.

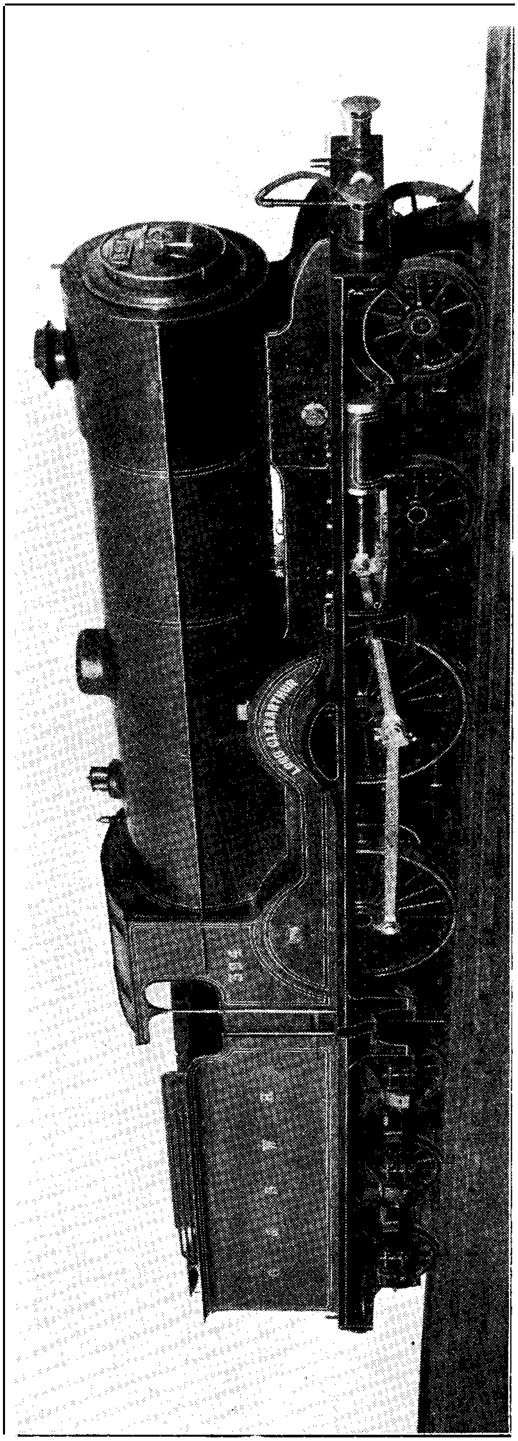
As these engines are true " double enders," and thus will be operated in either direction without turning, the driver's brake valve and other fittings are being mounted in duplicate so as to be available with equal convenience, whether driving chimney or cab end first.

Locomotive Weight/Power Ratio.

The writer of an article which appeared recently in a journal devoted to motor cycle subjects, made some comparisons between railway locomotives and motor cycles. He drew attention to the fact that one of the latest locomotives, presumably the 3-cylinder " Pacific " on the " Great Northern Railway," weighed 150 tons and developed 1,500 h.p., giving a ratio of weight-to-power of 224 lbs. per h.p. He went on to cite the case of a motor cycle weighing 180 lbs., and developing 6 h.p., a weight-to-power ratio of only 30 lbs. to the h.p.

In the opinion of the writer such comparisons are altogether futile, and that no engine or machine should be judged on such a basis, the correct standpoint being that of work performed per h.p. developed. On such a basis, the " Pacific " engine referred to, developing as a maximum 1,650 h.p. and hauling a train weighing 550 tons (or with its own weight, 700 tons), gives a showing of over 950 lbs. to the h.p., but as the *average* h.p. is very considerably less than that just mentioned, the weight hauled per h.p. developed is much greater. As a matter of fact, the writer has investigated this subject, and finds in many cases the average is .75-ton per h.p., and an everyday figure is .5-ton per h.p., whilst further observations showed that with a heavily loaded passeager train practically full, each passenger was being conveyed at a high speed at the expenditure of 1 h.p. on the average, leaving the question of weight out altogether.

Now the motor cycle cited by the writer of the article would, on an average rating, convey



The Rebuilt Four-Cylinder Locomotive for the London, Midland & Scottish Railway (Glasgow & South-Western Section).

two people, and the total weight is 574 lbs.. giving a ratio of $95\frac{1}{2}$ lbs. to the h.p., and, cf course, much more than 1 h.p. per passenger. No doubt these figures could be varied considerably in both cases, but those used are the ones selected for comparison by the author of the article referred to, and it only shows how impossible it really is to compare such widely different types of engines usefully. Certainly it is quite wrong to approach the subject on the basis of weight of the engine or machine and the maximum h.p. it is expected to develop. Obviously no locomotive could reach its maximum horse-poner or anything approaching it whilst running light, and that is what is assumed when the neight-power rating is employed.

HEAVY LOCOMOTIVE TENDERS.

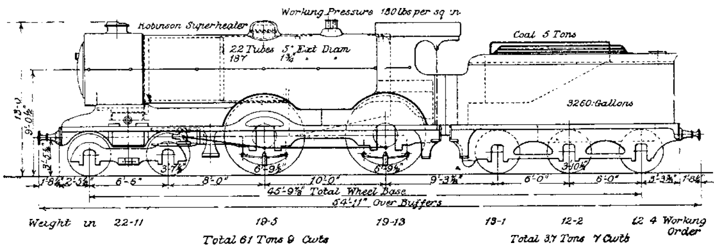
Locomotives that are called upon to make long runs without stops must of necessity be equipped with tenders of suitable capacity, and even where track water troughs are installed a heavy tender is practically unavoidable under modern conditions of working. The difficulty. of course, is that of fuel, for although it is possible to replenish the water supply whilst running, means have not and could not very well be devised for replacing coal without stopping. Thus, with the increased size of locomotives, hauling heavier train loads, fuel and water consumption are on a higher scale. and, consequently, the size and weight of tenders have also grown. In some cases the weight of the tender approximates to as much as 75 per cent. of the engine itself, and, as a non-paying load, it amounts to a serious drag on the propulsive energy of the locomotive. With this fact in mind the advisability of employing additional mechanism either in the form of a "booster" or of making the tender a self-driving unit is one to be considered, and. indeed, is being considered in Europe at the present time, following upon successful results obtained in the United States with the first-named appliance. A proposal n-as recently put forward to equip locomotive teaders with a pail of low-pressure cylinders taking steam from the ordinary high-p&sure ones on the locomotive itself, and thus curtailing the demand upon the boiler for live steam. Such a system would entail the use of articulated piping, and be a rather complicated affair, and it is to be assumed that the majority of engineers would prefer to utilise the "booster" class of merhaaism.

REBUILT FOUR-CYLINDER LOCOMOTIVE, LONDON, MIDLAND AND SCOTTISH RAILWAY (GLASGOW AND SOUTH WESTERN SECTION).

The first four-cylinder locomotive to be placed in service on railways in the United Kingdom

was constructed at the Kilmarnock Works of the Glasgow and South Western Railway about 26 years ago, to the designs of Mr. James Manson, at that time Locomotive Superintendent. The engine was placed in traffic in the month of April, 1897, and considerable interest attached to its appearance, mainly on account of its cylinder arrangement. As originally built, this locomotive, No. 11, had two inside cylinders, each $14\frac{1}{2}$ ins. diam. by 26 ins. stroke, and two outside ones, each $12\frac{1}{2}$ ins. in diam.

By the courtesy of Mr. R. H. Whitelegg, Mechanical Engineer (Kilmarnock), London, Midland and Scottish Railway, it is possible to reproduce herewith a photograph of the engine as just recently turned out from the Kilmarnock Works after rebuilding. The striking appearance of the locomotive before and after conversion can be gathered from a comparison of the two line drawings, whilst the photographic reproduction provides a basis for further comparisons.



The Rebuilt Four-Cylinder Locomotive for the London, Midland & Scottish Railway (Glasgow & South-Western Section).

by 24 ins. stroke. The boiler, in common with general practice at that time, supplied saturated steam to the cylinders. The total heating surface was 1,173 sq. ft., to which the tubes contributed 1,062 sq. ft., and the firebox 111 sq. ft., and a grate area of 18 sq. ft. was provided, a working pressure of 165 lb. per sq. in. being carried. The small size of the boiler, in

The boiler now fitted is of a large size and well arranged to give maximum capacity. The engine as rebuilt has four cylinders 14 ins. diam., the outside pair having a stroke of 24 ins. and the inside pair one of 26 ins. The boiler is equipped with a superheater of the "Robinson" type, having 22 elements, the total heating surface being 1,803 sq. ft., and

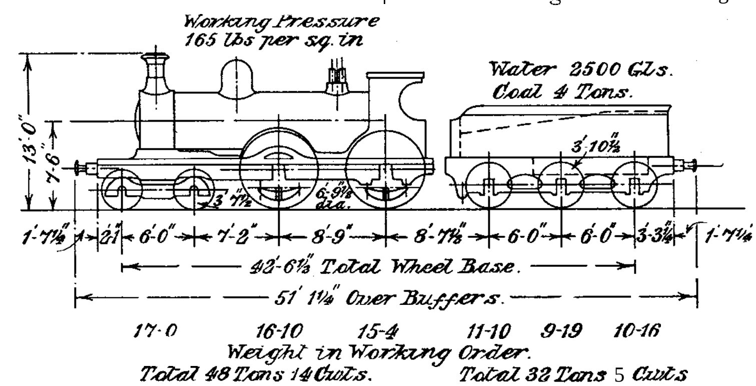


Diagram of the above Locomotive before Rebuilding.

conjunction with the use of four high-pressure cylinders, was remarked upon in various quarters at the time the engine was introduced, and in the light of subsequent developments, where four-cylinder locomotives are concerned, it might be considered entirely inadequate. At that period, however, the large boilers of to-day were not considered necessary, or even practicable, a leading factor of modern design being in the case of heavy main line locomotives, the provision of as large a boiler as could be mounted upon the frames.

grate area 27.6 sq. ft. The heating surfaces are distributed as follows:—

Large tubes, 357.41 sq. ft.
Small tubes, 1080.59 sq. ft.
Elements, 211.00 sq. ft.
Firebox, 148.00 sq. ft.

A working pressure of 180 lb. per sq. in. is carried. In its altered form the engine, exclusive of tender, weighs 61 tans g cwt. as against 48 tons 14 cwt. in the earlier design. The inside cylinders are formed in one casting, the outside pair being separate. Cross ports

are introduced, thus making it possible for one piston valve to control the steam of both cylinders at one side. The front piston valve head serves the front port of the inside cylinder, and also the back port of the outside cylinders, and *vice versa,* and by this means the rocking shaft with valve, valve spindle and valve connecting rod of the earlier locomotives are eliminated. The outside cylinders are identical in every respect, thus obviating the necessity for right and left-hand patterns. The piston valves have a diameter of 10 ins They were supplied by Allen and Simmonds, of Reading, in accordance with their patented design. The valves are arranged for inside admission and are actuated by Stephenson link motion as in the earlier type. Reversing is effected by means of steam reversing gear fixed to the right-hand frame close to the reversing shaft, and operated from the footplate, the cut-off in full gear being 77 per cent.

The reconstructed engine is, as seen, provided with a large and comfortable cab of the standard type now adopted on the Glasgow and South Western section of the London, Midland and Scottish Railway. The tender, which is of the self-trimming or hopper type, has a water capacity of 3,260 gallons, and coal capacity of j tons, whereas the original engine had a water capacity of only 2,500 gallons and curried 4 tons of coal.

In the original engine the rigid wheelbase was 8 ft. 9 in. This has been lengthened to 10 ft. in the reconstructed one, the total wheelbase, engine and tender being now 45 ft. $9\frac{7}{8}$ ins. as compared with 42 ft. $6\frac{1}{2}$ ins. In its original form the engine weighed in working order, without tender, 48 tons 14 cwt., the weight being now increased to 61 tons 9 cwt. Similarly, the tender, which weighed 32 tons 5 cwt., now turns the scale at 37 tons 7 cwt. The diameter of the wheels remains as before, namely, 6 ft. $9\frac{1}{2}$ ins., for the coupled wheels. and 3 ft. $7\frac{1}{2}$ ins. for the bogie nheels. The bogie wheelbase has been increased from 6 ft. to 6 ft. 6 ins. The engine as originally constructed developed a tractive effort of 15,832 lb. In its altered condition it develops 18,390 lb. at Sj per cent. of the boiler pressure.

This is one of those cases in which a locomotive, though having become obsolete where first-grade main line traffic is concerned, still offered a sufficient opportunity for conversion. As now running, it is practically a new engine and should rank among the most efficient 4-4-0 passenger locomotives in the country. Although the engine has been engaged in fast passenger traffic for a very short period it has', we are informed, already shown remarkable features of power output, acceleration and steady running at high speeds.

A Design for a Model Compound Condensing Steam Engine-III.

By "Axle."

(*Continued from page* 277.)

The piston rod stuffing boxes shown in Fig. 15 are made either from gun-metal castings or from bar. They should be machined all over. They are a push-fit into the cylinders and should be bored out $\frac{3}{8}$ in. diameter to suit the piston rods. Five 9-64th-in. holes arc drilled in the top Range and the bottom flange is tapped for three No. 5 B.A. studs. The studs should stand out $\frac{5}{8}$ in. The piston-rod gland is made of gun-metal and should be turned on the outside to an easy push-fit into the stuffing box. and bored to suit the piston rod. The flange is drilled to suit the studs in the stuffing box.

The cylinder covers, valve box, and stuffing boxes can now be used as template for marking off the position of the studs required in the

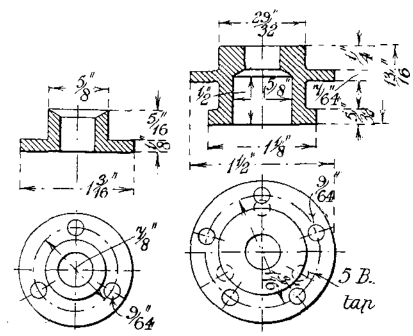


Fig. 15. Piston Gland, G.M.

Section and Plan of the Piston Glands.

cylinder casting, care being taken to see tha: the bevelled portions of the cylinder covers arc opposite the steam ports. In temporarily clamping up the L.P. valve box care should also he taken to get the centre lines marked on the castings registering exactly, and slide valve guide parallel to the cylinder bore. The studs securing the covers and valve box are 5-32nd-in. Whitworth, screwed about $\frac{1}{4}$ in. into the casting and standing out at least 1-32nd in. longer than the length required to take a full nut with the various covers jointed in position. The stuffing boxes at-e secured with five No. 5 B.A. studs and nuts, and can now be attached to the cylinders permanently. No jointing will be required for the stuffing boxes, except, perhaps, a little red lead paste.

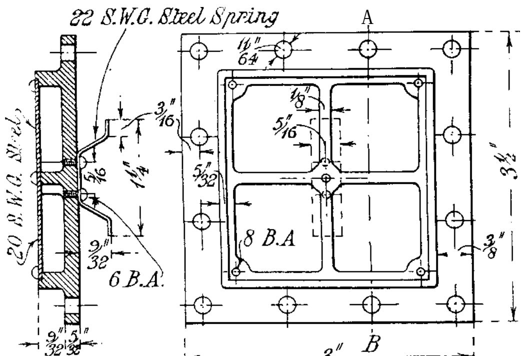
Fig. 16 shows the L.P. steam chest cover. It is made of cast-iron. If possible the lip or recess in the back of the casting into which fits the lagging

should be cast in, orherwise the lip may be dispensed with and the lagging allowed to be flush with the sides

The cover should be machined on the plain side, and filed up to size on the edges and polished. The lagging is secured with five No. 8 B.A. screws.

To keep the slide valve on its face a spring is fitted to the steam-chest cover. This spring is bent from a piece of spring steel 5-16th in. wide and 22 S.W.G. thick, and is secured to the cover with two No. 6 B.A. screws. The flange of the cover is drilled 11-64th in. diameter to suit the valve box.

Fig. 17 shows the H.P. piston, which is fitted with a block ring and two split rings. A plain piston with two grooves turned in for the rings can be used if desired, or the block ring mav be dispensed with. The body of the piston is made



Section on AB

Fig 16. L.P. Steam Chest Cover, C.I.

Elevation and Plan of the L.P. Steam Chest Cover.

in two pieces and each should have an extension cast on for holding the casting in the lathe.

Each casting should first be bored out 9-32nd in. diameter, faced at the joint, and rough turned to, say, 1-64th in oversize on the outside. The two pieces can then be mounted on a mandrel and turned to size. The body of the piston should be a good sliding fit in the cylinder, say, from .005 in. to .008 in. slack. The block ring is machined all over and should float between the flanges of the piston when assembled. It should be bored out to an easy fit on the: piston body and should be the same diameter as the piston flanges. The piston rings can be turned from the casting used for the block ring. The rings should first be turned up to 113-16th ins. diameter an the outside and 1½ ins. inside and parted off to thickness. A piece should then be sawn out, say, $\frac{1}{8}$ in. wide at 45°, and the joint filed up true. The ring should now be mounted on a faceplate, being held in place with a washer big enough in diameter to grip the ring all round, but leaving enough room to allow the tool to work on the outside of rhe ring. To close the joint of the ring while it is being set up a piece of wire can be placed round it and the ends twisted. Having set the ring to run as true as possible, it should be again turned to the same size as the bore of the cylinder. Without

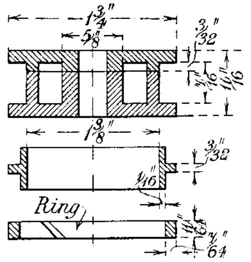


Fig. 17 H.P. Piston, C.I.

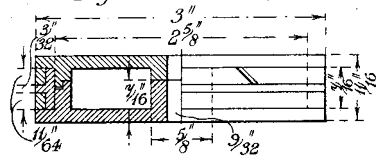


Fig. 18. L.P. Piston, C.I.

Details of the H.P. and L.P. Pistons.

removing the washer holding the ring, it should be gripped with small U plates. and bolts on the outside. Then the inner fixings can be removed nnd the ring bored out to its finished size, which is 117-32nd ins. diameter. The rings should be tried in the cylinder and the joint filed to obtain

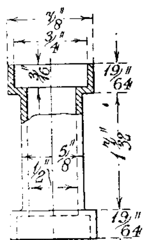


Fig. 19. H.P. Slide Valve, C.I.

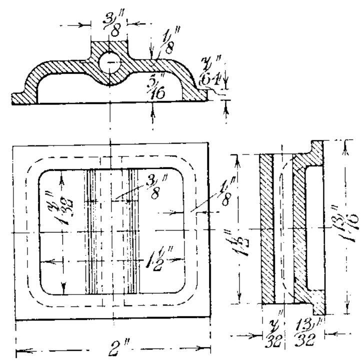


Fig. 20. L.P. Slide Valve, C.I.

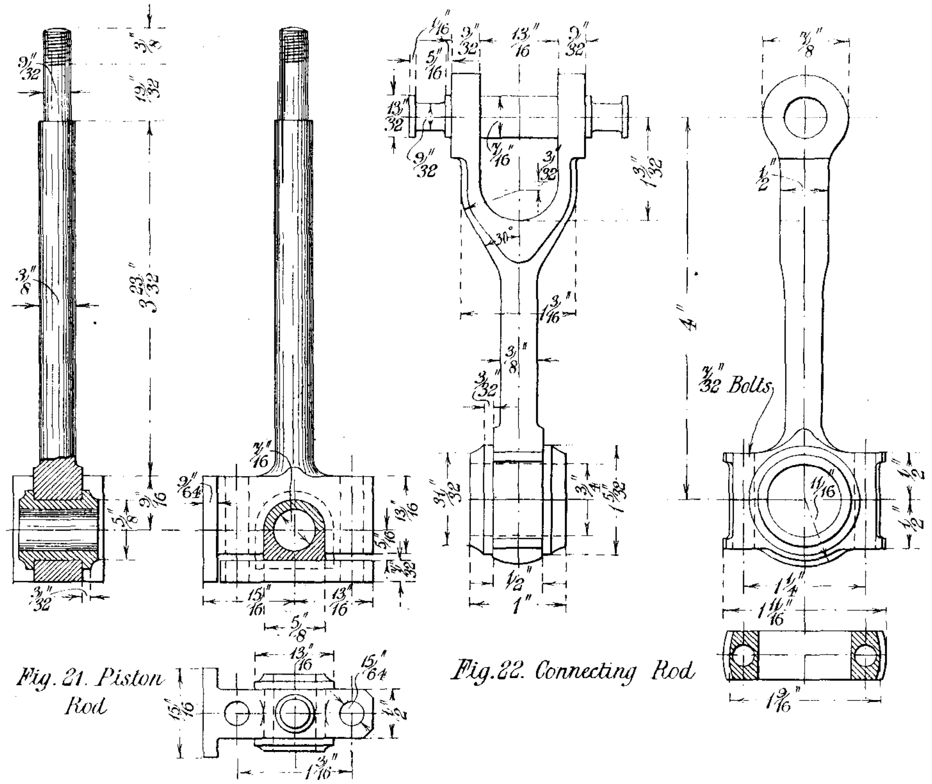
Details of the L.P. and H.P. Slide Valves.

not more than .01 in. opening when the ring is placed square in the cylinder in any position up and down the bore. The complete piston should now be assembled, and care should be taken to see that the rings are free to move when the piston is tightened up. The L.P. piston, Fig. 18, is similar in construction to the H.P. piston. The rings should be turned up to

3 3-32nd ins. diameter outside and $2\frac{3}{4}$ ins. diameter inside, after which $\frac{1}{4}$ in. should be cut at 45° before turning the ring up to size. Much that has been said regarding the H.P. piston also applies to the L.P. piston. The two pieces forming the body of the L.P. piston are registered together at the outer joint; the spigot on the loner portion being a push-fit into the upper portion.

The piston valve, Fig. 19, can be made of either gun-metal or cast-iron. No rings are fitted, as a plain piston valve is easily replaced when leakage occurs. It should be turned to a push-fit scraper. The sides of the valve should be parallel and a sliding tit between guides provided on the L.P. steam-chest.

The piston rods are made from mild steel forgings. The first operation is to machine the crosshead to size in the shaping machine, and rough turn the shank. The pocket for the top end brasses can be formed by drilling a suitable hole with a twist drill and cutting out the piece of metal not required with a saw, after which the sides of the pocket can be filed to shape. The bolt holes can now be drilled and a plate temporarily fitted across the end of the rod to form



Details of the Piston Rod and Connecting Rod.

into the liner. It can be ground in nith a little oil and fine emery. The over-all length should be left a little over-size to allow for adjustment of the steam edges when the valve is set near the completion of the model. The valve is machined all over and forms a piece of simple turning. The L.P. slide valve is made of cast-iron, Fig. 20. It should be faced on bath sides either in the lathe or shaping machine, and the edges filed up square to size. It is bored out 7-32nd in. diameter and faced at the ends to suit the valve washer and securing nuts on valve spindle. The face of the valve should be tested on a good surface-plate and the high places removed with a a centre upon which to finish turning up the rod. The rod should now be turned to size and the end screwed to suit a 9-32nd-in. slotted nut. The cap for the brasses should be made from mild steel bar. It is drilled to suit the bolts and the front corners are bevelled off at 45°, as shown in the drawing, Fig. 21. The top of the holes in the piston-rod are knifed to suit the bolt heads. The top end brasses are made from gun-metal castings. To machine a pair of top end brasses they should first be filed up flat at the joint and soldered together for boring out. Two top and two bottom pieces should be soldered together. The sides can be faced if the brasses

are mounted on a mandrel. The brasses should be a good fit in the pockets. The pistons can be fitted on to the rod and the nut tightened up. The top of the t-od can then be drilled for a 1-16th-in. diameter split pin. In machining the rod care should be taken to get the back and sides of the crosshead parallel to the shank and the hole through the top end brasses perfectly at right angles to the axis of the rod. TWO bolts 7-32nd in. diameter by 15-16th ins. long are required for both piston rods. In Fig. 21, the portion of the rod which fits into the piston is shown parallel. The piston thus bears on a shoulder with a rather small bearing surface. If desired a cone may be provided on the piston rod $\frac{3}{8}$ in. long, tapering from $\frac{3}{8}$ in. diameter to 9-32nd in. diameter.

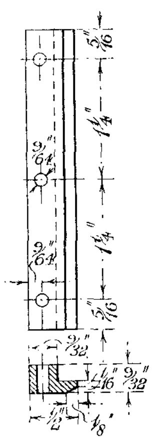


Fig. 23. Guide Bar, M.S.

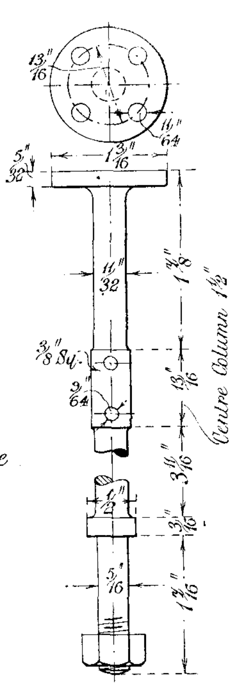


Fig. 24. Column

The Front Column and Guide Bar.

The connecting-rods, Fig. 22, are also made from mild steel forgings. The H.P. and L.P. rods are the same, except that the L. P. crosshead pin is extended to form gudgeons for the pump levers. The forgings should first be turned all over. The big end should be drilled 31-32nd in. and then split with a fine saw and the joint filed up true. The pieces can be drilled and bolted together and the sides faced up in the lathe. The hole for the crosshead pin should be now drilled and the fork formed by drilling a 13-16th-in. diameter hole, and sawing away the metal between the jaws. The jaws should be shaped to width and the eyes filed up to size. The bolt holes are knifed at both ends. Little need be said about the crosshead pins. They are turned smooth and parallel, and should be a light drive fit into the connecting-rod. The pin for the, H.P. rod should stand through about 1-32nd in. at each side of the jaws. The pin and bore of the bottom end should be parallel to each other. The bottom end bearings are turned up from gun-metal castings. Two half-castings should be filed up at the joint and soldered together. They should first be bored out to $\frac{3}{4}$ in. diameter, and then turned up on the outside and parted off. The bearings should then be lightly driven on short piece of bar that has been turned up to $\frac{3}{4}$ in. diameter, and the edges of the bearings radiused to suit the fillets on the crankpins. The bearings may then be unsoldered and the joint; cleaned up.

The guide bars are made of mild steel, and should be machined all over in the milling or shaping machine. The front inner edge of the lip is bevelled (Fig. 233. They are drilled, three 5-32nd-in. holes in each, for 4 B.A. bolts.

The front columns, Fig. 24, are turned from mild steel bar and finished bright all over. The top flange has four 11-64th-in. holes drilled in it. The holes should be knifed on the underside with a $\frac{3}{8}$-in. cutter. The *lower* end of the columns is turned to a push-fit into the bedplate, and screwed for a 9-32nd-in. diameter nut. The square portion on the centre column is longer than that on the outer columns. Care should be taken to obtain the correct relation between the sides of the square and the centre lines of the holes in the flange. The square portion of the centre column has three 9-64th-in. holes drilled in it, which can be marked off from the bracket carrying tha reversing gear.

Loose guide plates are fitted to the condenser. They are made of mild steel sheet and should be filed up true all over to $3\frac{1}{8}$ ins. by $1\frac{1}{2}$ ins. by $\frac{1}{8}$ in. thick. Six 5-32nd-in. holes are drilled in each to suit the holes in the guide bars and condenser columns. As no bending load comes on these guide plates they may be made of cast-iron.

We will now deal with the crankshaft, which is perhaps the most difficult piece of the engine to make. The crankshaft is shown in Fig. 25. It is made of mild steel and has two cranks set at 180°. It is the usual practice in two-cylinder marine engines to have cranks at 90°, and has the advantages of considerably reducing the range of twisting stress and of making the engine comparatively easy to start, for when one crank is on the dead centre, the other is in the position of maximum turning moment. But in a model these points are not of much importance, and with the idea of obtaining a better balance cranks at 180° have been adopted. The crankshaft shown has the eccentric sheaves solid with the shaft, and is made from a forging. To simplify the making, the eccentric sheaves can

be made of cast-iron and keyed on. Having obtained a forging for the crankshaft, the first thing to do is to remove some of the metal between the webs. This metal can be drilled and sawn out. The shaft should now be centred and the ends turned down to $\frac{7}{8}$ in. diameter, upon which should be fixed cast-iron throw-pins and journals. The crank-pins can be finished to size. The eccentric sheaves should also be finished to size. The throw-plates can then be removed and the shaft put in the shaping mnchinc to machine the sides of the webs, after which operation the shaft can be put back in the lathe and the main journals

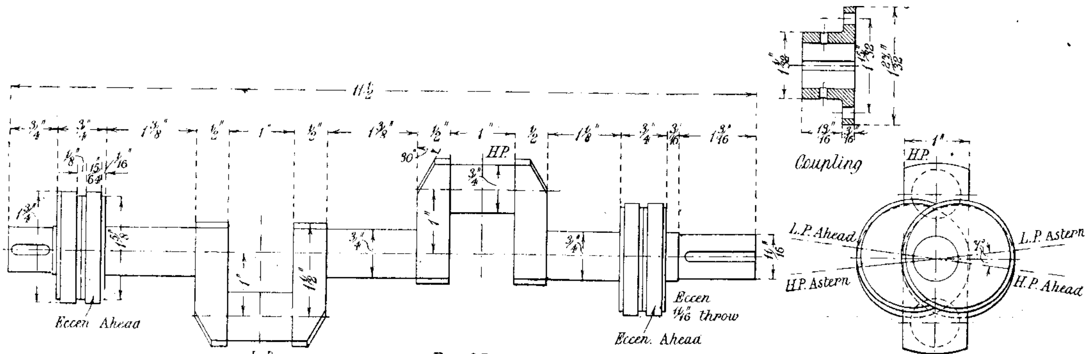


Fig. 25 Crankshaft

The Crankshaft and Diagram of Position of Eccentrics.

plates, large enough in diameter to carry the centres required for turning the crankpins and sheaves, say $2\frac{3}{4}$ ins. diameter bv $\frac{3}{4}$ in. wide. The throw-plates should be a driving fit on the shaft and secured with setscrews. The centres should be marked off on the throw-plates, and small holes drilled and countersunk for swinging the

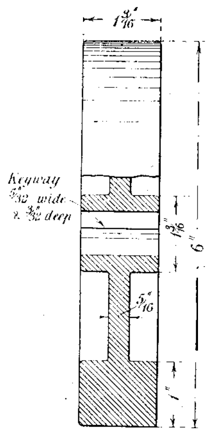


Fig. 26. Flywheel C.I.

Part Sectional Elevation of the Flywheel.

shaft in the lathe. The shaft should first be rough turned to $\frac{7}{8}$ in. diameter, and the eccentric sheaves also rough turned nearly to size. The outside edges of the webs should then be machined and bevelled, as shown on the drawing. The crankpins should now be turned and the inner edges of the webs faced. A fillet 1-16th in. radius should be provided on crank-finished off. The shaft should be machined smooth all over. The keyways at the ends of the shaft may now be cut 5-32nd in. wide by 3-32nd in. deep to suit the loose coupling and the flywheel. If desired, the coupling may be solid with the shaft, making it $1\frac{5}{8}$ ins. diameter by 3-16th in. wide, and drilled to take four 3-16th-in. bolts. The loose coupling may be turned from $1\frac{7}{8}$-in. diameter bar, and is bored a light driving fit on the shaft. It is turned up smooth all over. The flange is drilled for four 3-16th-in. diameter coupling bolts and the holes knifed with a $\frac{3}{8}$-in. diameter cutter. The coupling is drilled for a 3-32nd-in. diameter taper pin, which secures it to the shaft. The keyway is 5-32nd in. by 3-32nd in. deep. The flywheel is made of cast-iron, Fig. 26, and is turned all over. The face and edges should be turned smooth and polished. The wheel should be bored out to suit the shaft upon which it should be a light driving fit. A key 5-32nd in. wide which is sunk 3-32nd in. deep into the shaft secures the flywheel. As a safeguard against the flywheel coming off it may be further secured by a 2 B.A. screw tapped centrally into the end of the shaft and a 1-in. diameter turned washer. If the flywheel is required for a belt drive then the face of wheel should be slightly cambered.

(To be continued.)

S. A. F.—We do not quite grasp what your difficulty is, but possibly you will find a perusal of our handbooks "Electric Batteries" and "Induction Coils," 10½d. post free, from our Publishing Department, would put you on the right track.

An 0 Gauge Garden Electric Railway.

By R. W. C.

THE following description and accompanying plan and photographs of an o gauge garden model railway may be of interest to *M.E.* readers.

In order that the whole railway may be moved if necessary, it was decided to lay it on standard sized planks, 6 ft. by 69 ins. wide, thus just allowing for double track where necessary. To prevent warping, each plank is cross-battened in three places besides being screwed down to the supports at the ends.

Owing to the contour of the garden, in order to get a level track, one end had to be on piles while the other end is on ground level. The

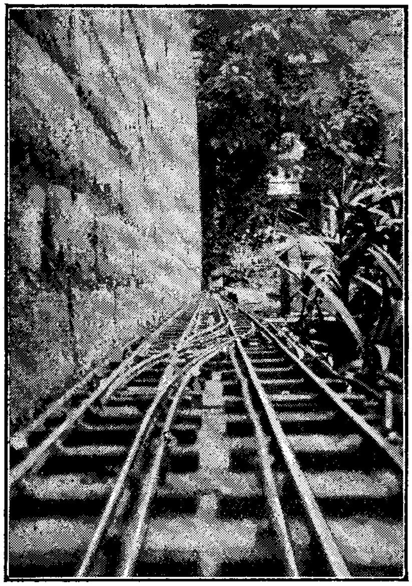


Fig. 10.—The Track showing Electrification at Cross-Overs.

pathway is spanned by a 30-foot single track model of the bridge over the St. Lawrence River, near Quebec.

Each cantilever is 11 ft. 10 ins. long, the centre span being 6 ft., total length of bridge being 29 St. 8 ins. with unsupported span of 17 ft. 10 ins. The height of the piers is 3 ft. and the height of the rail track above ground (water) level is 1 ft. 3 ins.

The bridge, which is not intended to be an exact scale model of the St. Lawrence Bridge, was, however, constructed on the same lines in order to get over the difficulty of traversing 30 ft. of garden where an embankment would have been impracticable. The bridge is entirely made of wood, screwed together, and was made up from eight triangular sections of the same shape, these being assembled into the two main cantilevers. The girders, of the K type, bear the entire weigh-the track girder in no way contributing to the strength of the bridge. The ends of the cantilevers are anchored

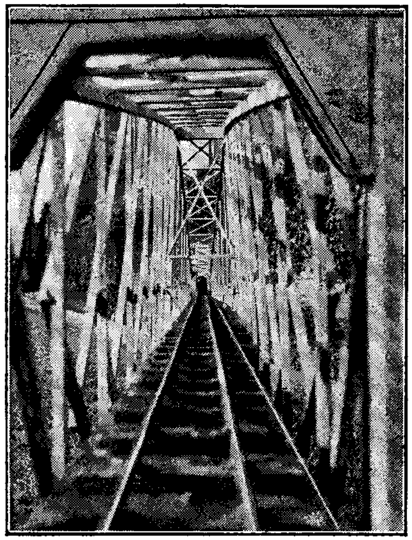


Fig. 9.-Looking through Bridge from the Southern End.

at the shore ends to piers filled with earth. The splay of the main cantilevers is from 5 ins. at the top to 8 ins. at the bottom, and gives ample resistance against wind. The main members of the girders are $-in. by $-in. deal, the smaller members being all

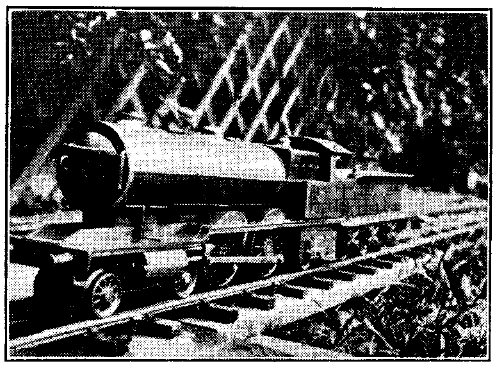
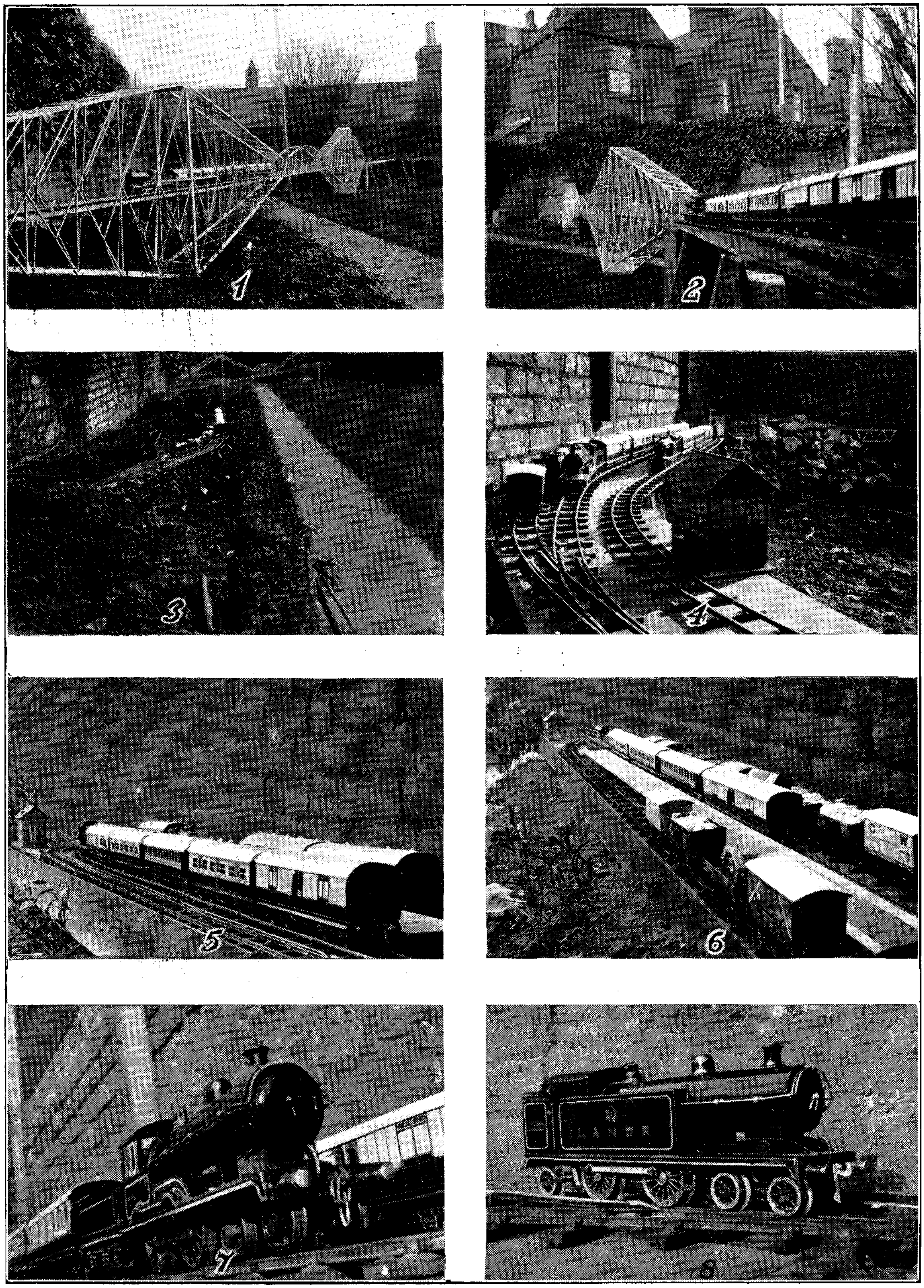


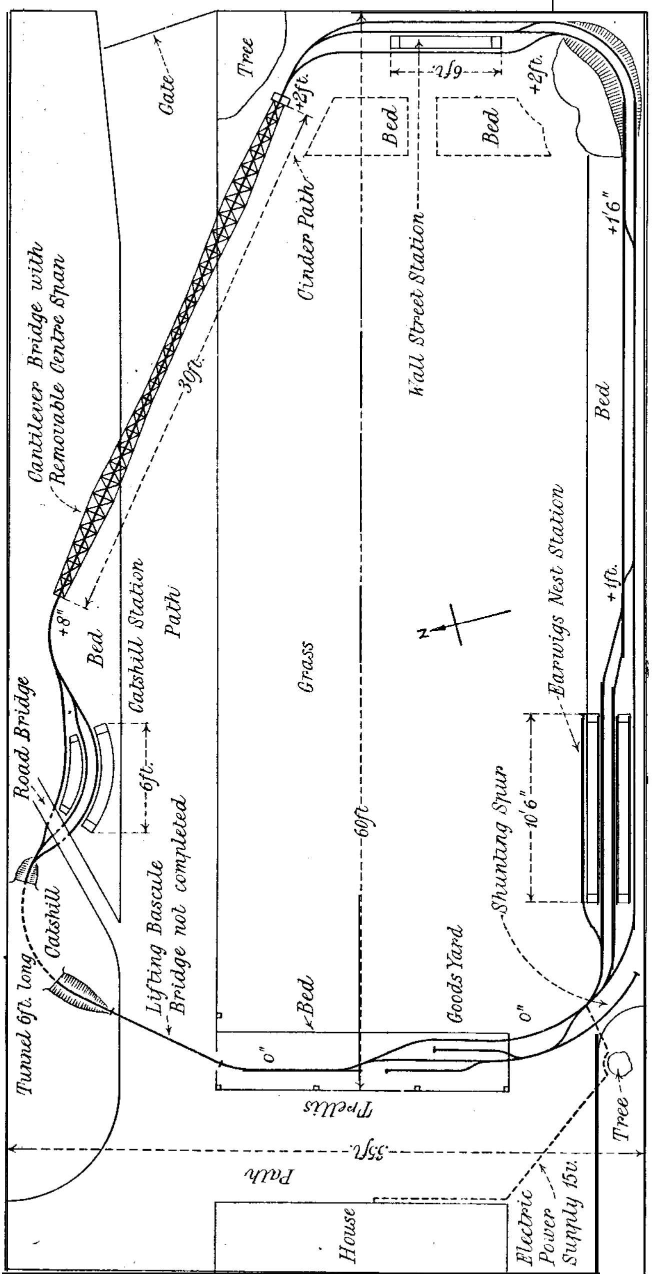
Fig. 12.—Another View of one of the **Locos.**

3-16th-in. by 3-16th-in. cut from laths. No. 00 brass round-head screws are used mostly and no splitting has been experienced, in all about 1,000 screws were used. The bridge is capable of carrying all loads likely on o gauge railway up to 1 lb. per axie.



SOME VIEWS OF THE 0 GAUGE GARDEN ELECTRIC RAILWAY.

The entire track is small scale brass permanent way, some by Messrs. Bassett-Lowke and Co., the remainder by Leeds Model Co. The former track is now some 10 or 12 years old and



LAY OUT OF THE 0 GAUGE GARDEN ELECTRIC RAILWAY.

has actually been outside over five years in all—all that required renewing on this railway being some sleepers and all the keys.

The type of chair without keys has been found more satisfactory owing to keys getting knocked out when rail cleaning takes place.

Steel rail has been tried, but, the rust which occurs makes running too heavy for 0 gauge where the weight of vehicles is not sufficient to wear it off.

All points are made at the works of the railway. In all, there are some 25 pairs, including four cross-overs—although not standard railway practice, it has been found better to solder the whole frog solid so that nothing can shift about and get out of alignment.

Where chairs requiring keys are used in the construction of points, leaden keys cut from lead sheet are used and found far superior to wooden keys. It is intended to replace all wooden keys with lead ones, as time permits.

Electrification was commenced in June, 1922, and is practically complete. The third rail is put outside, according to the latest practice, and it is found to be more satisfactory than the centre rail system owing to simplicity of construction at points (see photograph) and no trouble ever occurs from couplings hanging down and short-circuiting the mains.

The third rail is No. 12 or 14 S.W.G. copper wire soldered on to 1-in. brass flat-head screws, spaced about 6 ins. apart, the screw head being flush with rail level.

15 volt system is used and one locomotive taking 5 to 6 amps at this voltage will draw a train of 15 loaded trucks easily, and will get along slowly with a train of 22 loaded trucks, the train weighing 12 lbs. in this case, the engine weighing 3 lb., making a total of 15 lbs. The motor was constructed by Messrs Kays, of Acton, and was built into a tank locomotive. Being of the automatic reversing type it was found necessary to fit a small rotary hand reversing switch for operating reversal without returning to the reversing switch on switchboard. The switchboard consists of reversing switch, resistance regulator, ammeter, voltmeter, and automatic circuit breaker to break circuit at 10 amps. (can be altered for any current value) in event of a derailment causing a short-circuit on the line.

Experiments are at present being carried out with an 0 gauge steam loco. for outdoor use. Owing to the difficulty of obtaining a satisfactory

flexible connection to carry paraffin under pressure, it has been decided to build another locomotive as a "Baltic" tank instead of the 4—4—2 tender locomotive.

Up to the present the locomotive working at 50 lbs. pressure has pulled a load of 8 lbs., not including the engine weight, which is itself 5 lbs. This took place on a windy day without the correct flame protection at the firebox end. The present boiler is of the water tube type, but an experiment fire-tube boiler is on the way.

Possibly "L.B.S.C." can give some hints as to whether a $1\frac{1}{4}$-in. gauge solid fuel boiler is within the bounds of possibility, certainly methylated spirits are absolutely useless out of doors.

I know that the majority of model railway engineers look upon o gauge as a mere toy compared with the $\frac{1}{2}$-in. scale models, but to myself I find greater satisfaction in trying to make something as small as possible that will work

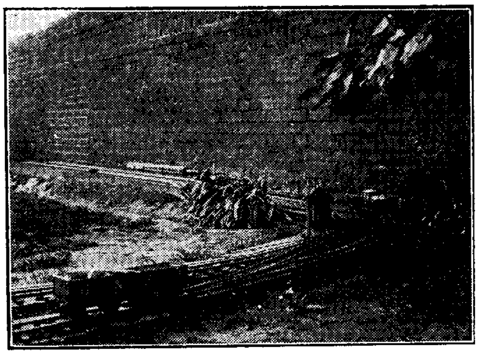


Fig. II.—A Corner of the Track looking East.

satisfactorily and also have a complete system of railway rather than build a model to run up and down a straight track.

I fear I have encroached, Mr. Editor, on your space rather more than I should, so I will end with saying that if any readers who have o gauge stock which they wish to test and have a good long track to run them on, I shall always be pleased to see them by arrangement.

The various views shown are: (1) The Bridge from the Sorth; (2) The Bridge from South; (3) General View of Bridge and Catshill Station under construction; (4) View of Wall Street Station from north, before construction of platforms; (5) Earwigs Nest Station after alteration; (6) Earwigs Nest Station before alteration; (7) The 4-4—0 Express Passenger Locomotive; (8) The 4—4—2 Tank Locomotive showing current collecting device and electrified rail.

J. H. B. (Sheffield).—No. We cannot altogether recommend them for this purpose.

Model Engineering Equipment and Supplies.

A Review of Current Technical Progress.

The "Abwood" Vertical Milling and Gear-Cutting Attachment.

THIS is a new lathe accessory, and is shown in Fig. 1 as set up upon a $3\frac{3}{4}$-in. type "R" "Milnes" screw-cutting lathe, in the actual operation of cutting a 48-tooth 16-d.p. wheel on a cast iron blank. The machine is remarkable for good workmanship in its construction, and that it converts a B.G. lathe at short notice into a double-geared vertical milling machine of high-duty capacity.

It consists of a main slide bracket, standing 12 ins. from the lathe bed face, which is devised to be firmly attached to a lathe bed in true alignment, by means of a tongue piece which fits between the lathe shears upon the under side of its planed base; a bolt and clamp providing the fixing. This main slide, which faces toward the tail end of lathe, carries a long saddle, capable of being clamped firmly, within reasonable limits, at any height on the slide, the lever on the front edge providing the clamping action. Upon the front of this saddle, and at the top, cast thereto, is a projection, carrying the front vertical slide, upon the screw-controlled saddle of which is mounted a long vertical spindle bearing. This bearing is gunmetal bushed, and carries within it a vertical spindle for actuating the cutters. There is to this spindle a ball-thrust at bottom of bearing, and fibre washer at the top, between the bearing and a pair of lock nuts. The spindle is bored $\frac{1}{2}$ in. throughout, and is opened out to No. 2 Morse taper at the bottom, so that cutters carrying this form of shank, duly end tapped $\frac{1}{4}$-in. Whitworth, can be drawn in, and locked, by a $\frac{1}{4}$-in. draw spindle stud-nutted at the top. As the saddle is operated for fine adjustment of feed by an outlying 10 t.p.i. square-thread screw, with horizontal handwheel, it carries the spindle and cutter with it. To maintain the drive, which is by a mitre gear on a cross horizontal shaft at the top, the horizontal wheel of the gear is set in a housing cast to the projection, and, being keyed to a spline on the vertical spindle, drives it at any elevation that the spindle may be put, within the limits of the saddle traverse. The vertical feed screw is divided for micrometer reading at the top, and, upon the front saddle at the other side, is a lever for locking this to the slide. The remainder of the drive is as follows:—The initial action is by a horizontal shaft, carrying at the mandrel end a No. 1 Morse taper shank, designed to be drawn into the hollow mandrel of the lathe, and, at the accessory end, a mitre

wheel. Short of the wheel is a bearing arranged to take vertical adjustment to admit of fitting it to different heights of centre. The mitre wheel drives its pair on a second vertical shaft, $\frac{5}{8}$ in. diameter, which wheel can. be adjusted on the shaft to proper depth; the shaft running on a foot step on the main frame, and in a bearing above the mitre gear. The rest of this shaft is splined, and drives thereby a third mitre gear in a housing on the main saddle, so that, at whatever height the main saddle is locked, it carries this third mitre gear to that elevation. There arc, therefore, three mitre gears, one between lathe spindle and vertical shaft, another between the latter and cross 12 ins. From the face of main slide to vertical centre of spindle is $5\frac{1}{4}$ ins. of overhang. Size of base where bolted to bed is 5 ins. by $4\frac{1}{2}$ ins.

In addition to the main bracket, a pair of dividing heads are added as an extra. These are seen in position on the boring table of lathe. The head centre carries a hollow mandrel bored for No. 1 Morse taper, which is drawn in. The tail centre has a push spindle, and both this and the mandrel can be efficiently locked. The rapacity of centres is, of course, dependent upon the length hack to front of boring table and the disposition of its slots, but the height of centres is 2 ins. As arranged, small-size division plates are fitted. They are of thick steel, with

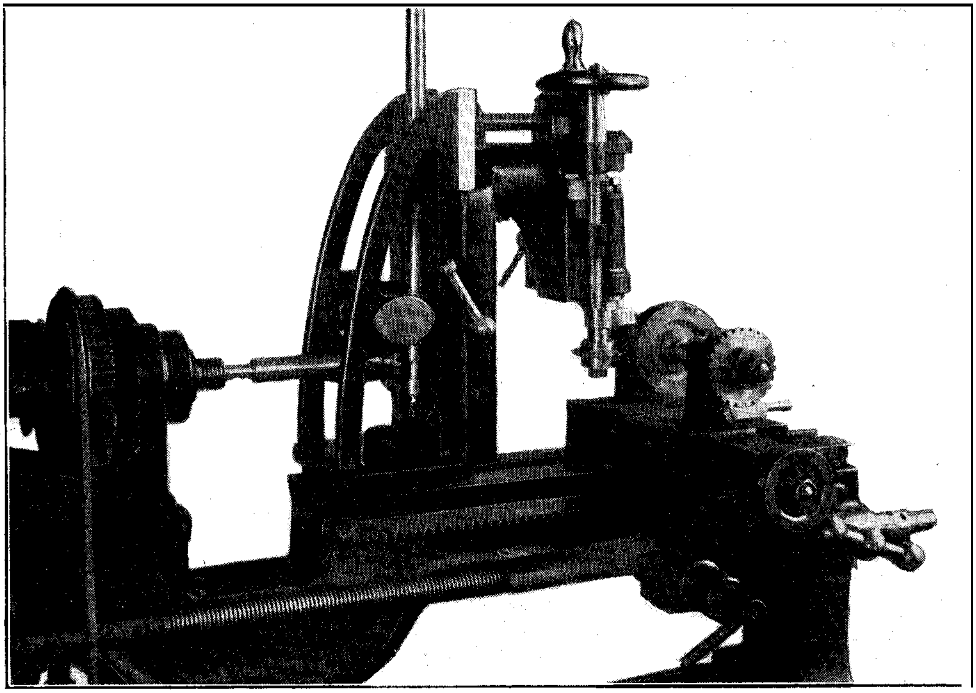


Fig. 1.—The "Abwood" Milling Attachment.

horizontal shaft at top, and the third from this shaft to the cutter spindle. The two latter pairs are protected by an efficient guard, covering them entirely in, and these take their positions automatically by the hand elevation of the main slide. It is only necessary; to adjust the first-follower mitre wheel to position, after having set the beariag for its driver.

Both the slides are scraped after machining, and fitted with strip adjusters, and all the gears are cut from the solid. The vertical shaft is of annealed silver steel. The cutter spindle is of carbon steel. The front slide screw allows of z-in. vertical traverse; and, with the main and front saddles at extremity, the maximum height from bed of lathe to nose of spindle is rectangular notches, checked by a toothed lever, the tooth of which is similarly rectangular and a non-shake fit. The lever is held in tooth register by a spring.

As shown in the picture, a standard No. 3, 16-d.p. cutter is mounted by a washer and nut against a fixed shoulder of the No. 2 Morse taper mandrei. This is elevated, by the hand and fine adjustments, to stand midway level nith the dividing head centres, and there locked. The blank of cast iron, $3\frac{1}{8}$ ins. diameter for 48 teeth, is similarlv mounted on a No. 1 Morse taper mandrel, having a drilled centre at the tail end. Both these fitments are drawn in. We found that, with the lathe on lowest speed, single gear, and using the treadle, it was quite

a simple matter to cut a tooth space to full depth at one cut across the blank, which is about $\frac{3}{4}$ in. wide, and this left a good finish. In this connection it is well to note that the elevation of a cutter mounted in this manner will allow of cutting wheels up to 16 ins. diameter, with the heads properly elevated also.

The tool is manufactured by the patentees, Messrs. Charles and James, Harrow Manorway, Abbey Wood, London, S.E.2. Very nicely finished and a thoroughly workmanlike fitment, which should be of great use to general engineers, not only for gear cutting, but for all kinds of end slotting, edge milling, keyway cutting, and a host of operations of this kind which can be conveniently carried out on a lathe. The fact that no overhead is required is a strong point, and that the gearing of the lathe enables heavy work to be carried out, the stress of which is well provided for in the design. In fact, the only limitation appears to lie in the limits of the available cross and longitudinal feeds of the lathe and size of its boriag table.

Workshop Topics.

The principal **items** *appearing under this heading relate to work done and other matters dealt with in* THE MODEL ENGINEER *Workshop at 66, Farringdon Street, London, E.C.4.*

About Bevel Wheels : Their Setting Out and Cutting.

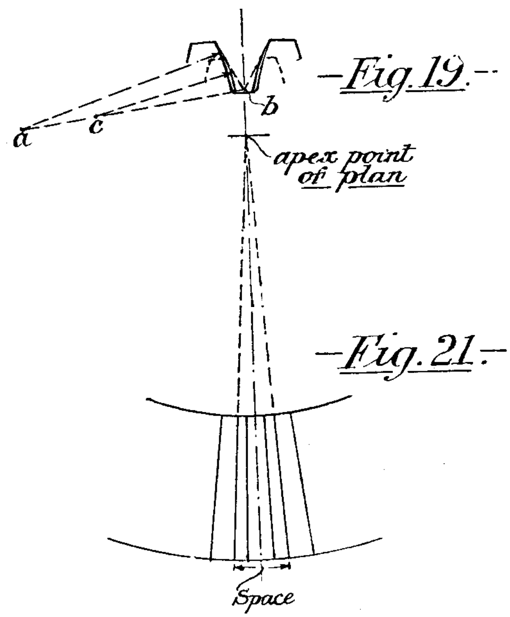
(Continued *from page 392, Vol. XLVII.*)

General Note.

Having, so far, described the shape of wheel blanks and teeth, we come directly to the subject of cutting these teeth, or the nearest approach to the process of accurate cutting that can be carried out by rotary cutters.

The Shape and Width of Cutter.

In Fig. 19 we see the relative appearance, in orthographic projection, of the back, or large end, of a bevel wheel tooth space to that of the small end looking directly along the path of the cutter. The point *b* is the apex point of the gear away forward beyond the small end. Why it is shown above the level of the tooth bottom is that the clearance space is usually cut parallel with the top line, or face, of the tooth of the other wheel, and not radial to the apex point, which it should be theoretically. As described before, all the outlines and centre lines of the teeth converge to this point, and what we have to notice more particularly here is that the radius of the tooth at the large end is struck from the point a, and that of the small end from *c*. The radius of the tooth, therefore, to be correct, varies all the way along the tooth between these two points, and, if we draw a line through all these radius points, it will be a straight line, which, if continued, will pass through the apex point, just as all the other outlines and centre lines shouid. It will be remembered that in setting out the tooth shapes (see Fig. 18, on page 302 of Vol. XLVII, Oct. 26, 1922, issue) we chose a 16 and 32 pair of wheels, and that the number cutter for the large end was for 72 teeth, or No. 2 cutter, due to the bevel angularity. It is of this pair of wheels, and the larger wheel, we show the relative outlines of the tooth shapes here in Fig. 19. One thing will be clear, that, if we used that identical cutter, it would shape the tooth space all right at the large end, but. in running right through would cut the space too wide at the bottom at the small end. We therefore must use a cutter of the large-end shape, but as narrow as the small end, just as indicated in Fig. 20.



—Fig. 19.—

—Fig. 21.—

Resetting the Blank for Widening.

Fig. 21 shows the plan of the space projected from Fig. 19. Having run the specially narrow cutter through all round to correct depth, with a 32 dividing plate, or other dividing mechanism, we have, so far, produced tooth spaces of the correct shape at the large end, but too narrow, and of correct width at the root at small end, but not the correct curvature of s'des. To finish the large end we must revolve the blank, as shown in Fig. 22, bringing the side of tooth into parallel with the cutting line, but in doing this, it will be seen, the finishing line will come on to the centre line of cutter, and, if we ran the cutter through with wheel in this pcsiticn, it would result in cutting away that side of the space half the cutter width too wide. This is obviated by traversing the whole setting side-

ways in the direction of the arrows, or traversing the cutter in the opposite direction, bringing the side of tooth into line with the side of cutter. Indeed, in this position the cutter registers again with the space at smail end, but will cut away the large end to its correct width on that side. Having carried this out all round, the wheel blank is first returned to its original position, *viz.*, with the cut right through the centre of space, and is then set in the opposite direction csactly the same circular distance, and side traverse, to correct, and the other side of the space cut, with the result that the tooth shape is exactly correct at the large end, and large end only.

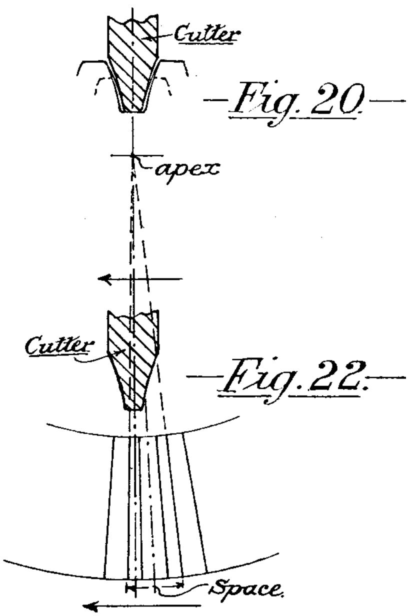
To obtain the correct circular movement of the blank, to bring the side of the tooth on to the centre line, we only require to note that the circular movement is equal to a quarter of the pitch and therefore the correct movement can be measured by a division plate having four times the number in it that there are teeth in the wheel. Thus, if we are cutting a 16-tooth n-heel, we require a 64-division plate, and, for the ordinary dividing, to use every fourth hole of the plate. Then, when setting the wheel round to bring the tooth side on the centre line, use only one division either way, in order to effect the Q-pitch movement. Why a $\frac{1}{4}$-pitch is the quantity required is that the width of a tooth and space, measured on the pitch line, are the same, and each are half the circular pitch ; therefore, to move the relative position of cutter centre from the centre of the space to the side will require a $\frac{1}{2}$-space movement, which is a quarter of the pitch. Next, the parallel side movement to bring the cutter back to register with the small end space will require a back traverse of one fourth the circular pitch of the small end. Suppose we are cutting 4 d.p. on the outside of our 32 wheel, and the length of the tooth is one third of the conical radius from the apex point, in that case the small end occurs at a radius of two thirds of the large end, in which case the d.p. of the small end is 3-2nds of the large end, and 3-2nds x 4 = 6 d.p. The circular pitch of 6 d.p. is .5236, and $\frac{.5236}{4} = .131$, or it requires a traverse of 131 " thou " to register. This, however, is given as a guide, and is of necessity approximate' only. By traversing a still cutter-into the small end it can be fairly well gauged what correction is required on these figures.

Fitting Required on the Small End Teeth.

Having taken the three different position cuts, the tooth space is as. near as most gear cutters will go, the rest of the corrections being carried out by filing the points upon either side at the small end backward towards the large end, and off to nothing at that position, in order to give the curvature of the tooth side its true conical curvature. A good guide, however, to this—which, by the way, is cnlr one method of doing the job-is to choose a standard cutter-not a narrow one-of size equivalent to the small end. That is, in the above case, a No. 2 cutter, 6 d.p. Run this cutter through centrally to the same depth as the other, and it should shape the small end correctly. Now, with the small end correct and also the large, the averaging out between the filing should be facilitated considerably.

Cutting Small Bevel Gears Approximately.

In cutting small Ion--duty bevel wheels much may be suggested on the score of using 3



Position of Blank after revolving the 1/4 pitch & before side traversing

standard cutter of medium size and taking only one cut with it. Suppose we require to cut bevel wheels of 30 d.p. outside, and of the ratio 32 to 16, as set out, and with a length of tooth one third the radial conical length. The size upon the inside will be 3-2nds x 30 = 45 d.p., and the mean d.p. is, therefore, 38 nearly enough. If a No. 2 38 cutter of standard width be run right through slightly deep to widen the large end a little, and similarly, for the 16 wheel, a No. 3 cutter of the same d.p. to the same depth, the wheels with a little fitting could be made to gear, but it should be clear that they are certainly not touching on the inside, and probably are only gearing at one point all the time, and that point is somewhere 'near the outside. If trouble occurred by the wheels running

hard on the outside., probably a short cut in (not right across), using a No. 230- or 32-d.p. cutter, would clear it. But these last proposals are only offered tentatively, and should not be adopted offhand, and then only by readers who are quite clear as to the formation of the gear they are attempting to cut. The reader who has mastered all that has been written in the foregoing articles on bevel gear formation will see, without the present writer wasting space to describe why, that in certain cases medium-sized cutting could be used, and the cutting angle decreased a little, so that this medium-size cutter cuts deeper and wider at the large end and shallower and narrower at the small end. In such a case, by tipping off the teeth of the other wheel on the inside, quite a tolerable gear can be obtained for light-duty purposes. It is not claimed, however, that these suggestions aim at efficiency in running, a characteristic of gearing that the model builder can sometimes disregard, if only he gets his gears to run smoothly and nithout much noise.

(To be continued.)

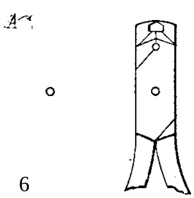
A Use for Broken Pliers.

By H. G. WATKINS.

Broken tools are often thrown away as useless. Very many such tools will often prove to be useful.

Quite recently I broke a pair of long-nosed pendulum pliers, as at A, in sketch. I did not throw them away but put them on one side in the tool cupboard as useless stock.

During last week I had need of some small tool to remove the small pins, used in fretwork, from a piece of work. The ordinary pincers proved far too clumsy and I had of necessity to look round for something more delicate.



It was then I thought of converting the broken pliers. The first thing was to soften them to make sure I could file them. This done I cut off the unbroken part of the nose and filed the remaining part to a circular shape. Next I filed the inside of the jaws to the shape shown in the diagram. The result was a pair of small pincers. These proved to be just the article required. The whole conversion took less than twenty minutes and it has proved to be time well spent, for I have since found them quite useful for removing all kinds of small nails, including tacks.

Radio Engineering.

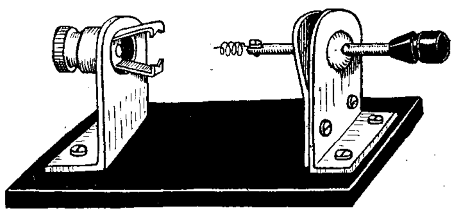
A Claw-Grip Crystal Detector.

By RICHARD TWELVETREES, A.M.I.Mech.E.; M.S.E., etc.

IT is often said that the onlooker sees most of the game, the truth of which was clearly demonstrated to me a little while ago, when watching the efforts of a friend to fix a crystal in the detector of a wireless set he had purchased.

Having procured the crystal, which was originally about $\frac{1}{4}$ in. in diameter, an attempt was made to hold it in the cup by tightening the set-screws. Whether this particular crystal was extra brittle or no I am not prepared to say ; but, anyhow, before it was half tight its dimensions were considerably reduced.

The next attempt took the form of using fusible metal to hold the crystal, and it appeared to me that that idea had many drawbacks. In the first place there was the danger of over-



The "Claw-Grip" Crystal Detector.

heating the crystal, secondly, the bulk of metal may have the effect of damping its action, and, finally, it is a messy job, especially if several crystals have to be experimented with.

In short, both arrangements seemed so crude that the idea occurred to me to use another method of securing the crystal in the holder. The manner in which this was accomplished is clearly shown in the accompanying sketch, from which it will be seen that the holder consists of an angle piece fixed to the base, drilled out to receive a small two-pronged claw. The latter is riveted to a screwed stud, held in position by a hollow knurled nut.

As the latter is tightened, the prongs of the claw close in upon the crystal, thus providing a firm grip with excellent electrical contact. The removal and changing of the crystal is most easily effected, without risk of damage or loss of time.

From numerous experiments I find that the claw holder gives improved detection, and from results obtained the idea appears to be quite a sound one. The claw holder is now protected and for the time I have been compelled to side-track my new aluminium speed-boat *Wooferloo II* to satisfy the clamours of friends who use wireless sets.

Practical Letters from our Readers

A Model Engineer's View of Clockmaking.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I have read the letter of "Pot-Boiler" in your issue of January, 11, 1922, and may I now be allowed to present the other side of the story to Mr. "Pot-Boiler"?

I am a merchant who knows more about locomotives, blowlamps, marine engines, high-pressure boilers of varying degrees of safety (or danger, as my sister says), and other such contrivances. My knowledge of clocks is confined to a painful experience that I had at the age of five years, when I took the kitchen clock to pieces and stuck the works back haphazard, hoping that it would not affect the working of the clock. I slept on my side and took my meals at the sideboard for two days after it. My brother is another skilled clockmaker. He, at the age of seven, opened the back of the grandfather clock in the hall. By highly skilled manipulation he made that clock strike 39, 47, 92 and 154 at one, two, three and four o'clock respectively, and he was highly pleased with himself! He then removed some gadget inside and the hands revolved at a fine speed. He was rather disappointed in the performance of the hour hand, as it was slower than the other one.

However, a few questions and the answer will show Mr. "Pot-Boiler" what I mean.

I wanted a sure and certain coupling that would enable me to slip coaches at various points of my $\frac{1}{2}$-in. scale line. Who made it for me? A clockmaker. And that coupling is fitted to 490 coaches and other vehicles and has never once failed to uncouple or remain coupled as required.

I made a model light cruiser and fitted her with two turbine engines, and she goes in the sea. The turbine itself is after the fashion of the Rev. W. Bredin Naylor's design, as illustrated on page 41 of "Model Steam Turbines." She has twin screws and geared-down turbines. Who made the gears for the reduction and synchronisation of the shafts? A clockmaker.

I built a giant model liner, 11 ft. overall. She sails in all seas. Who made the engine room telegraphs so that not only are the gong signals heard in the engine room, but the two sets of triple-expansion engines are started, given any speed from full ahead to full astern, and in all ways controlled by ringing from the bridge to the engine room by turning the pointer of the telegraph on the bridge to the speed you want as indicated on the dial? A clockmaker. On that same ship you steer from the wheel on the bridge in the orthodox manner, and there is another wheel on the after-bridge. There is, incidentally, a pointer on the bridge proper telling you exactly the position of the rudder. There is also on that bridge a rev. counter telling you the speed of your engines. All these things were made by a clockmaker.

I wanted a scale model clock for my Euston Station. I was made one no bigger than a halfpenny. It goes and keeps time. I have about 100 of these little clocks now on ships and in stations. I built a tower in imitation of that of a very famous clock in London. I wanted chimes. I got them. In the club to which I belong there are very many power boats that are s&going-big vessels with powerful engines and fitted out in detail. The biggest up to date is a model of H.M.S. Lion, 15 ft. long, with guns that fire in broadsides or singly. Her speed is 1[illegible] knots. To Messrs. Bassett-Lowke and Stuart Turner we are indebted fur many things on that giant craft. But for the things that made her possible and a seagoing proposition we are indebted to her owner (late, alas !), who built her, engined her and made her a living, breathing thing of majesty and beauty and the flagship of a club where enterprise and skill are not lacking. He was a clockmaker in a small way. She was the last effort of a long and useful life devoted to the art of the fine worker and a lover of all kinds of models. He did not despise the tin toy engine, nor did he puff himself up over the finest model ship I have ever seen. And he made it. He was a sahib.

He died two months ago, leaving in his will provision for the distribution of all his models among his fellow members of the club. To me he left the Lion. He was carried from his little cottage to his last rest by an assortment of railway, power boat, yacht, wireless and clock enthusiasts, and there were over two hundred model engineers at his funeral. One of the conditions of his will was that his name was never to be published outside the club in connection with his work. His coffin was draped with a large standard with the arms of the club on it, and his hammer and cold chisel were buried with him. In honour to him my railway was closed down for a month. There was no activity, marine, workshop, wireless or other form of model work in the club for that period. For one has gone from among us whose name will live, and the numerous monuments to his skill to be found on many a ship and, engine are fitting reminders of him. Yes, we are a powerful, enterprising, keen club, where criticism is sharp and often unkind. But we can never replace "Daddy, the Clocksmith."

The moral is this: in the model world we cannot afford to lose the company of the clocksmith. His work is an ideal which we should bear in mind and strive to attain, though few of us will ever attain it. He is an obliging fellow, who will make you what you want in an

intelligent way, but to him the finest of our work is a rough job, and to us he is a man who commands respect. THE MODEL ENGINEER is a paper essentially devoted to fine work, and is, I suppose, more for the loco man and speed boat wallah than for the clocksmith. But why shouid we grudge so fine an artisan a few pages of interest in our journal, considering what we owe to him? Personailp, I have very little interest in clocks. I can merely stare in open-mouthed wonder at such work. But I like to see articles and letters about clocks in the *M.E.*, and I read them.

So what I say is, " Welcome, Mr. Clocksmith ; long may you remain in our midst, and all power to your elbow."-Yours faithfully,

" LINKHEAD."

A Small Model Steam Engine.

To THE EDITOR OF *The Model* Engineer.

DEAR SIR,-I thought that the photograph herewith of a miniature model engine might be of interest to some of your readers. It was made bv myself entirely, every part being cut from solid mild steel. It is remarkable on account of its smallness, standing as it will, complete on a " Swan " match box. The flywheel is just the size of a penny, and the bore and stroke is 5-16th in. only.

Although made on gas engine lines, it works on steam or compressed au-, the latter being favoured on account of its cleanliness. I have had it running for two hours at a time on steam however.—Yours faithfully,

VINCENT UNDERHILL.

Charging Through Rectifiers.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—As I am in difficulty with a Noden valve rectifier, I am hoping you will be able to find room for this letter in the *M.E.*, as some other readers may have had better luck.

I feel sure that the subject will be one of general interest, as owing to the "wireless" boom, many readers, like myself will want to use the A.C. mains for charging accumulators I have referred to the *M.E.* Handbook So. 1 on this subject and have also gone through Mr. E. T. Painton's exhaustive articles in the *M.E* of November 17 to December 22, 1921, but have had no success. Using a transformer to reduce the voltage to 25 v. the current through a two-cell rectifier, with a 2 v. celi on charge was 13 amps ; after about 35 minutes one jar was boiling, and the current 16 amps, though strangely enough the other jar was stone cold. The lead of the hot jar had turned a chocolate colour.

Mr. Painton in his article says " transformer not essential," but i do not know what would have happened with the full voltage of 200.—I am, yours faithfully, C. T. MASON.

Repairing Calendar Clocks.

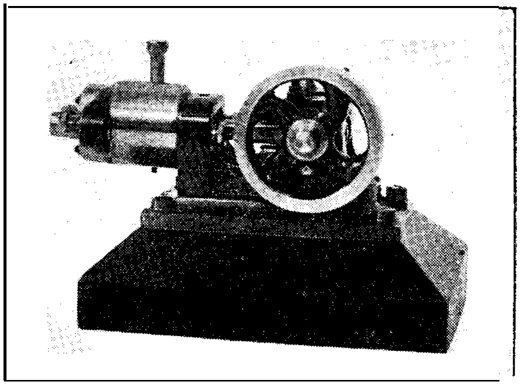
To THE EDITOR OF *The Model Engineer.*

DEAR SIR,--in reply to Mr. Brooker's letter in your February 22 issue, re calendar movement for grandfather clock ; the kind he describes is that which is most usually found in these clocks.

The ring of figures has to be revolved by hand at the end of every short month. Thousands of grandfather clocks were made on this principle, in fact I have seen more with it than without. It is called a simple calendar.

A perpetual calendar u-as invented by M. Brocot, which gives the correct days for all the months and years, including leap year. Separate dials show the name of the month, the days of the month, and the days of the week; it also shows the phases of the moon, and the equation of time, or the difference between solar and mean time.

It is a complicated arrangement, and although I cannot say that it is never applied to a grandfather clock, personaily I have never seen one. whereas I have seen very many of the former



A 5-16-in by 6-16-h Working Model Steam Engine.

A description of the perpetual calendar is given in " The Watch and Clockmaker's Handbook, Dictionary, and Guide," by Mr. F. J. Britten, pp 67-71. Price 13s. 6d., post free, from Percival Marshall & Co., Publishing Department, 66, Farringdon Street, E.C.4.

In my own grandfather clock the month figures were painted round the dial, just inside the hour figures, and the indicator was in the form of a central second hand. The latter is now gone, also the motion work for driving it, as is often the case in these old clocks.

With regard to whether the maker is still in business I am afraid ! can give no information. The name on the dial is, however, not necessarily that of the maker, as the seller very often puts his name on the dial of a clock. The

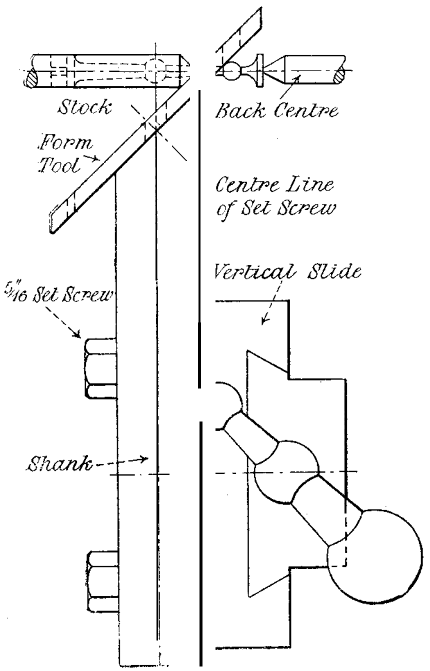
maker's name is, however, often stamped upon the dial plate.—I am, sir, yours faithfully,

RAYMOND F. FREKE.

Making Stanchions for Model Steamers.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—With reference to Mr. A. Dunn's remarks about stanchions for model steamers in your issue of February 22. I have been up against the same trouble as Mr. Dunn, and finally got over all difficulties by making a form tool, as shown in sketch below. In my case the cutter was made from a piece of old flat file and tempered to a dark straw colour. Note that all cutting edges must



Using a Forming Tool Mounted on the Vertical Slide for Machining Model Stanchions.

have clearance, and the usual three degrees will do. It is difficult to show this clearance in a small sketch. The shank should be a good stout bar, mine was $\frac{7}{8}$ in. by $\frac{7}{8}$ in., and the whole tool was held in the vertical slide to get height adjustment. I held the stock in the chuck and used the back centre to steady the job. My stanchions were about 2 ins. long and made from brass wire $\frac{1}{4}$ in. diameter. The work was done on a $4\frac{1}{2}$-in. foot-lathe, and paraffin was used as coolant. They took two minutes each to make and I could drill them (in a simple jig) in 30 seconds each. There is probably not much demand for these goods or the "trade" would reel them off like smoke with the aid of a small automatic and ditto boy.-Yours faithfully,

ERNEST W. FRASER.

Data on the Running of Two Notable Locos.

To THE EDITOR OF *The Model Engineer.*

DEAR SIR,—I read with considerable interest the article which appeared under the above heading in your issue of February 8, which dealt with the performance of Mr. Crebbin's two locomotives "Aldington" and "Cosmo Bonsor."

The article in question makes no reference to the extraordinary efficiency of both of these engines. "Aldington" evaporated 10.7 lbs. of water and "Cosmo Bonsor" 10 lbs. of water per lb. of coal. In this respect they appear to be somewhat better than the best modern full size engines in England to-day. In this connection it may be of interest to refer to your issue of January 15, where Mr. Lake furnished particulars of a remark-able American locomotive in which every possible effort was made to secure the maximum efficiency. In the last paragraph of that article we are informed that 9.7 lbs. of water was evaporated per pound of fuel, and this was considered "phenomenal."

Messrs. Babcock and Wilcox, of water-tube boiler fame, have published a book entitled "Steam: Its Generation and Use," which contains a vast amount of useful data. Among other things it states that as the result of a number of tests extending over three months it was found that their boilers gave an average evaporation of 11.42 lbs. of water per pound of combustible. The article adds: "This is within four per cent. of Rankine's standard, and within $7\frac{1}{2}$ per cent. of the highest theoretical efficiency under the conditions in which they were made. It is not probable that any kind of boiler fairly tested will ever beat such a record. As about 15 per cent. is lost in chimney gases and in radiation it is evident that all claims to over $12\frac{1}{2}$ lbs. evaporation should be looked upon as unreliable."

Messrs. Babcock and Wilcox will have to look to their laurels as that evaporation of 10.7 lbs. by "Aldington" is uncomfortably close on their heels.

Now, who says model steam engines are notoriously inefficient?-Yours faithfully,

CLYDE WOLVERTON.

Society and Club Doings.

The Society of Model & Experimental Engineers.

FORTHCOMING MEETINGS.—At Caxton Hall, commencing at 7 o'clock, Wednesday, April 11, Wednesday, May 2, Thursday, May 31, Tuesday, June 26, Thursday, July 19.

COMPETITIONS for the Challenge Shield and the Bronze Plaque and Medal will be held at each of the above meetings, particulars on notice board and may be obtained from the Secretary. Get the particulars, then go in to win. If you

don't try, you can't succeed, 'out if you don't succeed, you can deserve to.

WORKSHOP.—The Workshop will be closed for Easter on Saturday, March 31, and Tuesday, April 3.

DEMONSTRATIONS. — Monday, March 26, "Marking Out," by Mr. H. A. Allman; Monday, April 16, "Brazing, Silver and Soft Soldering," by Mr. H. G. Eckert; Monday, April 30, "Shaping," by Mr. C. S. Barrett; Monday, May 14, "Drilling and Drill Grinding," by Mr. H. G. Eckert; Monday, May 28, "Finishing Work," by Messrs. H. Hildersley and A. L. Franks; all to commence at 7 o'clock.

RUMMAGE SALE.—Monday, April 9, and Monday, May 7, at 7 for 7.30 o'clock--all entries must be made by 7.30.

Full particulars of the Society with form of application for membership, and visitors' cards for meetings at Caxton Hall and the Workshop on work nights may be obtained from the Secretary, F. H. J. BUNT, 31, Mayfield Road, Gravesend, Kent.

Manchester Society of Model & Experimental Engineers.

Our usual meeting took place at headquarters, Clarion Café, Market Street, on March 6. Two new members were elected. Mr. Mills gave a short paper on "Failures," this was well received and provoked discussion and interest. It also elicited several confessions of failures--myself amongst others. A vote of thanks was tendered to Mr. Mills.

FORTHCOMING MEETINGS.—April 3, cancelled. April 17 open meeting for models, etc.; May 1, Mr. Wright gives a paper on "Springs," which should be very interesting.

EXHIBITS SHOWN: Mr. Mills, Larch pattern slide-rest; Mr. McLarnon, vertical steam engine, $\frac{3}{4}$ in. b $\frac{3}{4}$ in. bore and stroke; Mr. Nappy, built-up pulley wheel for overtype engine, a fine piece of work; Mr. Worthington, tracing of compound engine; Mr. Westmoreland, nearly complete water-cooled petrol engine, 9-16th in. by 9-16th in. bore and stroke; Mr. Hardacre, an armature (8 slots) wound.

F. STUART NICHOL, Hon. Secretary, 405, Stetford Road, Manchester.

Newcastle-upon-Tyne S.M.E.

An ordinary meeting was held at the Plough Inn, Byker Bank, Byker, Newcastle, on Thursday, March 8.

After the reading of the minutes, etc., and the transaction of formal business, discussions on various subjects took place between the members. Will members please note that from March 8, 1923 all future meetings will be held at the Elephant and Castle Hotel, Low Friars Street (Back of Clayton Street), Newcastle-on-Tyne. Members are asked to bring all models, etc., to the meeting on Thursday, March 22, when we are making arrangements with the I.C. people to have our photographs taken.

There are many persons who have applied for application forms of membership which have not yet been received, and we ask these particularly to kindly return them as early as possible to the Secretary, who will be glad to hear from them.

Rummage sales are now being arranged and anyone wishing to buy or sell is asked to inform the Secretary.

During the last two weeks nine new members have been elected.

A few visits, etc., are at present being arranged for the months of June, July and August, and as soon as the arrangements are completed they will be published under this heading. Lectures, papers, etc., are also being ar-ranged and any member who is willing to help us in this way is asked to notify the Secretary as early as possible.

The Society's Library is now available to members, although we are still somewhat short of books. The Librarian is Mr. J. H. Wallace, 195, Mowbray Street, Heaton, Newcastle-on-Tyne. It is hoped that a good attendance will be seen at our meetings, and an invitation will be extended to anyone interested in the Society if they will communicate with the Hon. Secretary, Mr. B. GILBEY, 46, Raby Street, Byker, Newcastle-on-Tyne.

Blackpool S.M. & E.E.

At a meeting of the Blackpool Society of Model & Experimental Engineers, held at the Waldorf Café, Church Street, Blackpool, on March 7, it was decided to make premises at Johnson Road Laundry, Blackpool, the permanent headquarters.

It was also decided to fit up there, as funds permit, a workshop, to be open each Tuesday and Wednesday evening, to commence on Wednesday, March 21, 1923, at 7.30 p.m. The opening night to take the form of a wireless concert.

Mr. B. Haigh, who has had long experience in mechanical and model work, has kindly offered to help less skilled members in the construction of their models, etc.

There are several members who have not attended meetings very well lately, owing to their working on the building up of wireless receiving sets. Mr. H. Blackburn has kindly offered to give these members every assistance in their work (wiring of panels, winding of coils, etc.), he himself just having completed a 4-valve receiving set and loud speaker.

It is earnestly hoped that all members will attend.

Persons wishing ta join please communicate with J. CRUMBLEHULME, Hon. Secretary, 38, Reads Avenue, Blackpool.

Wakefield and District S.M.E

GENERAL MEETING.—At a very well attended meeting on February 23, it was unanimously agreed that the half-yearly general meeting be held at the Y.M.C.A., on March 23, commencing at 7.30 p.m., also that the Hon. Sec. make inquiries *re* the proposed workshop mentioned at a previous meeting. All members are requested to be present at this meeting for the election of officers and deciding dates for 1923. New members are still coming in.

Hon. Secretary, F. STANDALOFT, 6, Pretoria Street, Sandal, Wakefield.

Dublin Society of Model & Experimental Engineers.

This Society had a most interesting and enjoyable evening on Friday, March 9, when Mr. S. H. Medcalf read a paper on the "History and Development of the Electric Underground Railway."

The lecture and 86 slides were kindly loaned by the Electric Railway Co., Broadway, Westminster, and dealt with the undertaking since its inception up to the present day. The slides showed the rolling stock-old and new-Greathead shield, automatic stops, drivers' telephones, lifts and escalators, ticket machines, power house, safety devices, air-shafts, tunnel borings, etc., all of which were of great interest to engineers.

On Friday, March 23, Mr. A. R. W. Montgomery will give a demonstration of cylinder patterns and castings

Members are reminded of the forthcoming Eshibition on April 19, 20, and 21, to be held in the Engineers' Hall, and to "speed-up" their work.

EDWIN HAINES, Hon. Secretary, 14, Ashfield Park, Rathgar, Dublin.

News of the Trade.

The "Voltalite" Magneto Cycle Lamp.

Owing to the steadily increasing demand for the "Voltalite" Magneto Cycle Lamp, the makers are able to notify a reduction in prices, due to the greatly increased production. The revised prices are as follows: No. V2 head set, 21s., No. V6 head and rear set, 25s., No. V7 de luxe head set, 25s., and No. VS de luxe head and rear set, 30s.

A new leaflet on the subject, printed in three colours will be forwarded to our readers on application to the Universal Electric Supply Co. Ltd., 4, Brown Street, Manchester.

Radio Supplies.

We are notified that Messrs. Radio instruments Limited, of 1L, Hyde Street. New Oxford Street, W.C.1, have appointed Mr. C. B Gresham, A.M.I.E.E. (late sales manager of the heating department of Messrs. H. W. Sullivan, Limited), as sales manager of their radio department as from March 1, 1923.

Accumulators for Wireless.

We have received from Messrs. Industry and Commerce Alliance, Limited, 4, Vernon Place, Southampton Row, London, W C.1, their special net price list of C.A.V. accumulators, which they are stocking as a regular line.

The prices quoted are for lots of less than a dozen. For dozen lots they allow an extra discount of 5 per cent Quotations for larger quantities may be had on application. Carriage is free in the London area, and forward for country. Their terms are 2½ per cent. monthly on approved accounts, 3¾ per cent. for cash, and 5 per cent. for cash with order. The list will be sent to any of our readers on request. All accumulators are sent unfilled and uncharged.

Notices.

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